Energetic Ion Mitigation Methodology for High Power Plasma Thruster Cathodes, Phase I

Completed Technology Project (2013 - 2013)

Project Introduction

The presence of energetic ions, that appear under high cathode current operation, stand as a showstopper to the realization of high power electric propulsion. Physical barriers such as the use of carbon electrodes (e.g. NEXT) are no longer sufficient as ion energies measured greatly exceed the sputter threshold of even carbon. Unless this problem is addressed, the prospect of inadequate life looms. The benefits of high power electric propulsion missions supporting human operations in particular would be left unfulfilled. This effort aims to fully characterize the conditions under which energy ions occur by documenting ion energy spectra over a range of representative operating conditions. At these conditions, the effort will implement two novel methods of essentially defeating the energetic ion production mechanism: 1) magnetic shorting and 2) gas injection. While the concept of injecting gas to quench energetic ion production has been demonstrated in the past, we take the approach a step further by 1) elucidating the mechanism by which gas injection actually quenches energetic ion production and 2) implementing a novel gas applicator that would conserve propellant thereby allowing for gas implementation without a significant efficiency sacrifice. Past studies have shown that energetic ions form under conditions of high current. No satisfactory understanding of how these are formed or how to mitigate has been communicated. This effort aims to address both issues. The focus of the proposed effort directly addresses a problem that stands in the critical path for the development of high power electric propulsion. Without a solution to the energetic ion lifetime issue, it is difficult to imagine the actual implementation of high power electric propulsion for actual missions. This proposed effort aims to generate a methodology and apparatus for the elimination of energy ions in high current cathodes.

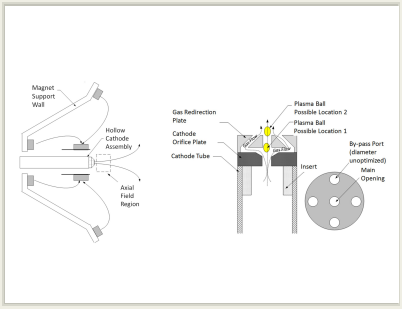

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Table of Contents

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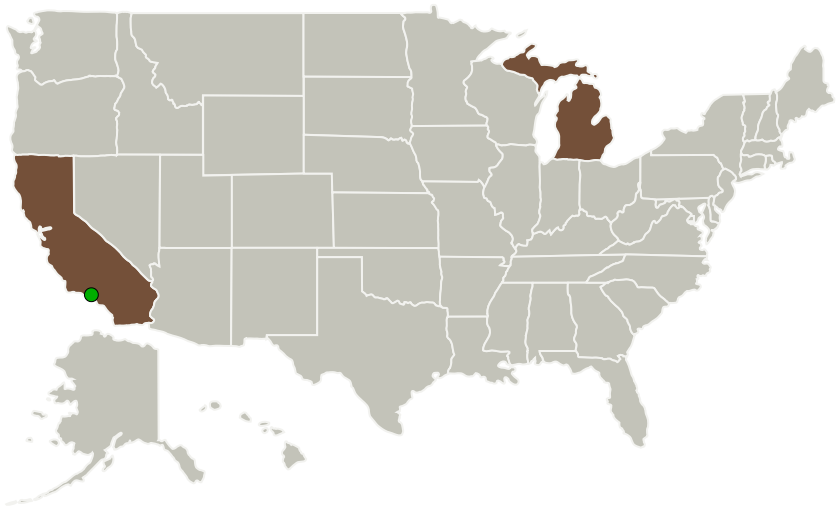
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
ElectroDynamic Applications, Inc.	Lead Organization	Industry Minority-Owned Business	Ann Arbor, Michigan
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Michigan

Project Transitions

May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138129)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

ElectroDynamic Applications, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

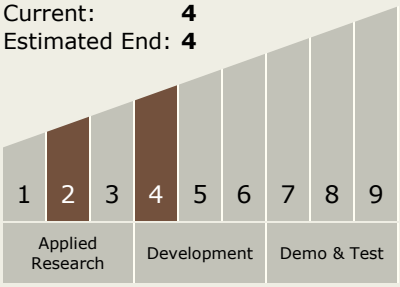
Carlos Torrez

Principal Investigator:

Christopher Davis

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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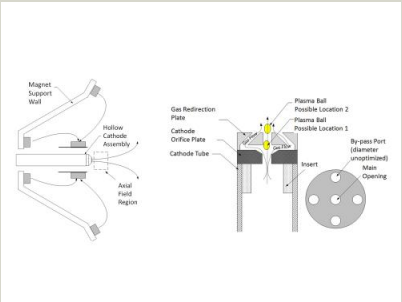
Images



Project Image
Energetic Ion Mitigation Methodology for High Power Plasma Thruster Cathodes
(https://techport.nasa.gov/image/126099)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System